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THE BLUEBERRY

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SECTION I

BLUEBERRY CULTURE

BY

E. L. EATON

The blueberry, one of the most relished of the native fruits, has been an important item of diet in Eastern Canada, and to a lesser extent in the West, ever since the first white settlers reached this part of the continent. Its appearance, flavour and wide range of habitat all contribute to a well-merited popularity. Because the fruit is gathered so widely, no complete record of local yields and sales is possible and any estimate based on commercial shipments certainly represents a mere fraction of the total crop harvested. All of these Canadian shipments are fruit of the wild or semi-wild, low-bush type. Commercial production of the cultivated high-bush varieties is yet in its infancy in Canada although a few individuals, inspired by the success of the crop in the United States, have started small plantations. One fairly large development is in production in British Columbia.

Review by Provinces

Nova Scotia

McLaine (10) quoted in 1931 that "approximately 43,000 acres are devoted to blueberries in the western counties, 33,000 of which belong to blueberry associations, and the remainder are privately owned. With the rotation of burning, two-thirds of the acreage is in bearing each year. Cumberland county is also a large shipper; in the eastern section of the province there are large acreages, but the industry has not been developed." In 1940 only one blueberry association existed and the acreage controlled was small.

While the shipments vary considerably from year to year, over 46,000 crates of fresh fruit were shipped, chiefly to Boston and New York, in the season of 1930. This number has been much reduced since restrictions have been imposed on shipments containing maggot.

The canning trade is using an increasing quantity of fruit. In 1940 over 35 tons were shipped from one small district in Cumberland county to a canning plant in the province. Carload shipments of frozen berries were also made to the United States.

Prince Edward Island

Wild blueberries have not been commercialized as greatly in Prince Edward Island as elsewhere but both soil and climate are suitable, and the industry is expanding rapidly. McLaine (10) estimated that around 200,000 pounds were marketed in 1930. More than three times this quantity of frozen fruit was shipped in 1940 to Central Canada and United States (8).

New Brunswick

Immense areas of the province have been burned over at various times and grow little else but blueberries and other heath plants. No complete estimate of the blueberry acreage is available, but in 1939 around 4,000,000 pounds were

marketed, 2,500,000 from Gloucester county (8). In Charlotte county systematic care of the blueberry barrens with burning every third year is a common practice and is being introduced elsewhere. Dusting with an arsenical for the control of the blueberry maggot is also common. Similar care in other parts of the province would vastly increase the output. Many are shipped frozen and many are sent fresh to canneries in Maine. Shipments in 1940 were much less than in 1939, but the price was higher and the total return greater (8).

Quebec

The largest area of blueberry land in Quebec is in the Lake Saint John district with smaller areas in Charlevoix county and elsewhere. The estimated yield is about that of New Brunswick. Several canneries and chilling plants have operated and Montreal is a large receiving centre for shipments from points outside the province.

Ontario

Most of the wild blueberry land is in the newer areas of the province where the fruit is gathered and sold locally. Canning operations are limited and the estimated crop is considerably below that of Quebec.

Prairie Provinces

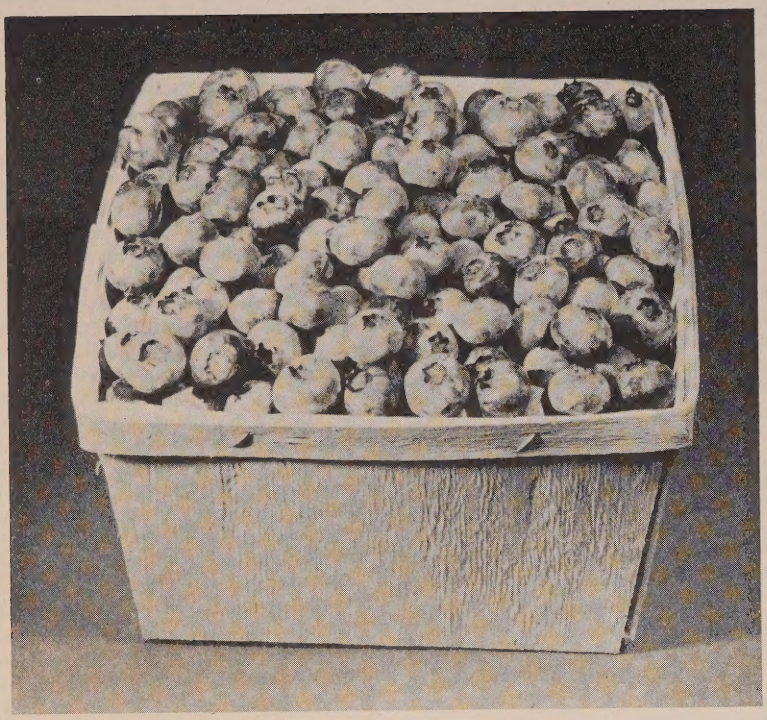
Limited areas in each of these provinces grow native blueberries, but they have not been recognized as of great commercial importance.

British Columbia

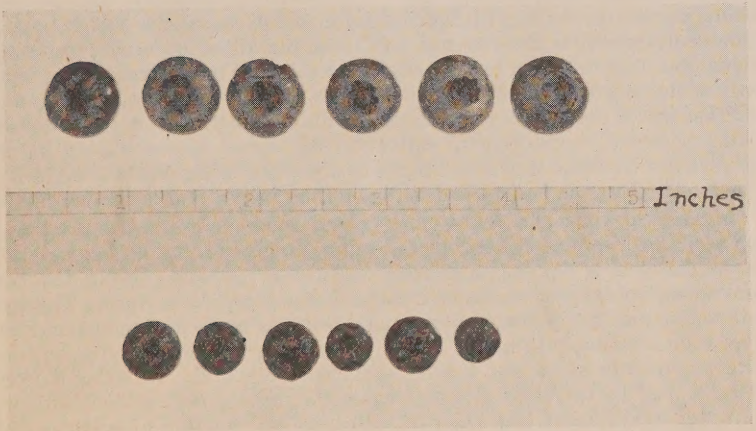
According to J. J. Woods of the Dominion Experimental Station, Saanichton, B.C., the main commercial trials with blueberries in British Columbia have been made on pure peat soils on Lulu Island. The total available area of this type of soil is in excess of 40,000 acres. This raw peat land is covered with a variety of vegetation, a large portion of which consists of young pine trees and native species of cranberries and low-bush blueberries. The average water-table is high, from one to three feet below the surface. Where blueberries are grown some drainage by open ditches is necessary. Gates in ditches should be arranged for so that control of run-off water may be obtained. Under such conditions soil to within an inch or so of the surface is always moist. During the winter and early part of the growing season the water-table should not be higher than 14 inches from the surface and during the picking season a two-foot water-table is satisfactory. The pH of the soil and water is in both cases less than 4. On a low-lying mineral soil at Sidney, V.I., there is a quarter-acre block of seedlings which was planted in 1935. There is sufficient evidence from this small block to prove that such soils, while not giving the growth that is obtained on Lulu Island peat, offer commercial possibilities.

In preparation for planting, land must first be cleared of trees and stumps and much of the surface growth may be burned off when care to prevent deep fires in this operation is exercised. The area may then be ploughed and disked for a full season before planting in order to kill the native growth. Or the top 4 inches, which is the approximate depth of root penetration, may be skinned off by cutting the surface into narrow strips 2 feet wide and 4 inches deep and then grubbing this layer off with a potato hook. For initial planting this procedure may be modified by cutting out 2-foot strips every 6 feet and plants may then be set. Later the area between rows should be cleared off.

At the present time there are only 10 acres of high-bush blueberries being grown in B.C., the greater portion of which is being produced by E. W. Johnston & Bros. who commenced their blueberry farm 18 years ago. A new area of approximately 25 acres will be planted in 1942-43 by the Western Peat Co. on an upland bog, the plants for which are being grown at the present time by W. T. Suckling. The bog for this new area has had removed from it a crop of commercial peat.



A Pint Box of Cultivated High-bush Blueberries.



A Contrast—(Above) Cultivated High-bush Blueberries. (Below) Selected Wild Low-bush Blueberries.

The original blueberry bushes planted on Lulu Island were all seedlings and the disadvantage of this kind of stock is now apparent. There is considerable variation in the size and vigour of plants. While the majority of plants produce marketable fruit, in any considerable population there are some plants which, through lack of vigour or small size of berry, are of no commercial value. The established growers are turning to named varieties but there is relatively little information as to the most suitable kinds. Johnston Bros. have raised a very large number of seedlings and have attained considerable success in a few outstanding new varieties which they are now propagating to plant out new acreage.

In the majority of cases, plants have been set 6 feet apart on the square which appears to be satisfactory. Two- or three-year-old stock is used and when the older plants are set in the fall they will produce a small crop the following year but will not be fully grown for 9 years. Weeds should be kept in control by cultivation, the amount of weed infestation depending to a considerable degree on the care with which the new land was originally prepared. Grasses may prove troublesome and should be controlled before becoming firmly established. As blueberries bear their crop on one-year-old wood a considerable amount of pruning is required each year, approximately one-third of the old wood should be removed each year and whenever cutting can be done at the ground level it is better so than to cut high at a point where a new shoot has grown. Only very limited trials have been made with fertilizer but definite responses have been obtained from complete mixtures relatively high in phosphate and potash. As with other crop plants, the amount of fertilizer to be used must be based on the vigour of plants which is estimated by the growth of new wood and average yields. Acre yields on established areas in B.C. are between two and three tons per acre.

The picking season will continue for approximately 10 weeks, starting in some years as early as June 15. It is desirable in any given plantation to have varieties of different maturity to extend the season as much as possible, especially when the fresh fruit market is being supplied. As yet, in B.C., no blueberries are being processed but where canning and quick-freezing are practised an extended season is not so necessary. To harvest the crop approximately 20 pickers per acre are needed. For the fresh fruit market the berries are put up in strawberry hallocks and crates. They may or may not be graded as to size such as those for table use and pies. Considerable ingenuity may be used in making attractive crates. Blueberries have to sell at a price which puts them in the luxury class for dessert fruit. In small plantings robins can prove a very serious pest once the fruit commences to ripen but in larger areas their depredations, while severe, are not so noticeable. A blueberry will remain in good condition for several days on the plant and also will hold up for 4 or 5 days after picking before it commences to shrivel. Only sound berries should be crated and varieties on which the skin breaks easily when being picked should be discarded. The berry is best picked with a rolling rather than a pulling motion.

Messrs. Suckling and Johnston have had good success in propagating both from seeds and hardwood cuttings following, in general, the directions given in this publication. Mr. Suckling takes hardwood cuttings during the winter, stores them in peat and plants to frames during March and April. The rooting medium is a mixture of sand and peat and beds are made any convenient length, 3 feet wide with sides 10 inches high. The frames are kept covered with onion sacking to provide shade and keep the atmosphere humid. Watering is frequent but care must be exercised to guard against fungus growth at the soil surface. The water used is peat bog water of high acidity. Rooting of cuttings is from 75 to 90 per cent successful. Some varieties propagate much more easily than do others.

Botanical Relationship

Gray's Manual places the blueberry in the *Ericaceae* or the Heath family and among the *Vaccinoideae* or Whortleberry subfamily. This subfamily contains the genus *Chiogenes* or snowberry, the *Gaylussacia* or huckleberries and the *Vaccinium* which includes the cranberries, the deerberry of New England, Ontario and southwards, and the various blueberries.

The most common blueberry is listed by Gray as *Vaccinium pennsylvanicum,* Lam. It is described as being found from Newfoundland south to Virginia and extending west as far as Saskatchewan, Illinois and Wisconsin. It is recognized by the bright blue fruit, either with or without bloom, and leaves that are smooth and shining, both above and below.

The smaller *V. p. angustifolium* (Ait.), Gray, is described as having narrower leaves and found on higher elevations and farther north.

Another variety, *V. p. nigrum* (Wood), is the common low black blueberry, in which the fruit is black and usually without bloom. It is frequently found among the blue type.

V. canadense Kalm. is described by Gray as later than *V. pennsylvanicum,* and having downy leaves. A rare form bearing white fruit is given the subspecies name *V. c. chiococcum* Deane.

V. vacillans Kalm. is also differentiated by a slight foliage variation.

The high-bush blueberry, now a definitely cultivated shrub, with many named varieties, is listed by Gray as *V. corymbosum* L. *V. c. amoenum* (Ait.) Gray, and *V. c. pallidum* (Ait.) Gray, resemble *V. corymbosum* except for small foliage differences.

A black high-bush type, said by Gray to be a week or ten days earlier, and often associated with *V. corymbosum* is given the name *V. atrococcum* (Gray) Heller.

Since the blueberry has become domesticated there is an increasing opinion among growers and others that this classification is too complex. As many species are intra-fertile and cross readily, such a wide range of characteristics is readily explained.

The Low-Bush Blueberry

This is the chief blueberry of commerce. A wide range of varietal type exists in every natural blueberry barren. These individual types are frequently found in clumps as though each one might have originated from a single chance seedling and later spread by roots. This tendency is particularly noticeable where an old cleared field has been permitted to grow up naturally to blueberries. Earliness, flavour, size, colour, firmness and shape of fruit; size, vigour and productiveness of plant; density of colour, shape, resistance to disease on the part of the foliage; and many other differences are readily seen.

Notwithstanding this mixture of varietal types the blueberry stands up to shipment better than most other small fruits.

Soil Requirements

Low-bush blueberries are found on nearly every soil type, but they thrive best on well-drained areas, free from competing plants. Most blueberry soils are highly acid, but Chandler (3) states that applications of ground limestone totalling as high as 18 tons per acre over a 5-year period did no injury.

Cultural Practices

Burning.—As the blossoms and fruit of the blueberry are borne on the growth of the previous season, a large proportion of strong, new shoots is needed, and these can only be forced by severe pruning. Fire has been accepted as the simplest method of removing this old growth and therefore it is customary to

Low-bush Blueberry, Old Growth.
(Note lack of fruit buds except at tips of twigs.)

Low-bush Blueberry, Growth of Current Year.
(Note strong fruit buds on upper three-fourths of stem, smaller leaf buds on lower portion.)

High-bush Blueberry, Growth of Current Year.
(Note fine strong fruit buds at top.)

divide the area into three parts, burning one-third each year. A large crop is usually produced the year following the burning, a fair crop the second year and fire is put over again the third year. Firing more often than once in three years is believed to destroy too much humus and a longer interval between burnings reduces the yields.

The work of burning is done in early spring while snow is still lingering in the woods as a fire protection, and before the green grass appears. Where there is not enough old material to carry the fire, old hay or straw is sometimes scattered lightly over the ground the previous fall. The snows of winter crush the mulch around the old stems, thus aiding in a thorough clean-up.

Burning the entire area without leaving any "islands" is important as the old plants form a refuge for maggots and other insects.

Weeding.—Many other plants thrive under the same conditions as blueberries and are frequently troublesome. Among the common ones are sweet fern (*Comptonia peregrina* L.), common brake or bracken (*Pteris species* L.), sheep laurel or lambkill (*Kalmia angustifolia* L.), bayberry (*Myrica calinensis* Mill.), sweet gale (*Myrica gale* L.), wild spiraea, hardhack or meadow sweet (*Spiraea latifolia* Borkh) and wild rose or brier (*Rosa blanda* Ait.)

Workers in New England state that the sweet fern can be controlled by regular mowing between the first of July and the middle of August. Late fall cutting is said to increase its spread. In Yarmouth, N.S., annual mowing in July, August or September has been equally effective.

The common brake or bracken is very sensitive to calcium arsenate dust. Where this is used regularly to poison the maggot, the weed is not a problem.

The other plants mentioned resemble the blueberry so closely in their requirements that no easy control has been devised. In the absence of better information, mowing in midsummer is suggested to discourage further spread.

Fertilization.—Fertilizer applications have not become a regular part of wild blueberry management. Workers in New England report definite yield increases from treatments of complete fertilizer, but competing plants also benefit by the fertilizer and unless these are thoroughly removed the yield of blueberries is reduced. Where the land is relatively free from other plants, treatments of 1,000 pounds per acre of a complete fertilizer such as 5-9-8 are considered profitable. The fertilizer is applied early in the spring, before the buds open, either the first or second fruiting year. Early application is essential as the foliage is very sensitive to fertilizer burning.

The High-bush Blueberry

The high-bush blueberry grows wild in many parts of New England, but in the Maritimes it is only common in the three western counties of Digby, Yarmouth and Shelburne in Nova Scotia. Here the winter temperatures (2) approach those of New England (7) and in fact the mean temperatures for December, January and February are slightly higher at Yarmouth than at Amherst, Massachusetts.

The plants usually grow from a single, large, woody crown, and under favourable growth conditions reach a height of 6 feet or more. They spread from suckers less freely than the low-bush type.

Marie Victorin (9) suggests that the low-bush blueberry is found in more northerly regions, not because it is more hardy, but because it is lower than the winter snow line and is thus protected from frost injury. The high-bush type on the other hand is less common because it lacks this natural protection.

Individual plants with a crown several inches thick, relatively free from the suckering habit, but recumbent in form, are found wild on fertile soil in the solder areas where only low-bush berries are usually recognized.

Although the cultivated high-bush blueberry has not been grown very widely in Canada as yet, there is evidence that it is adapted to regions beyond those where the wild form is found. As breeding and selection work continues the development of still more hardy sorts may be expected.

Soil Requirements

Under natural conditions, the wild plants are usually found in swampy places, on hummocks or ridges above the general water level. In most of the earlier cultivated areas, an attempt was made to imitate these natural conditions as far as possible. Soil with an abundance of subsoil moisture but well drained and having a generous supply of organic matter has usually been recommended. It is important that the water level should be at about 15 inches during the growing season; higher levels during the dormant season do not appear to cause harm. The use of surface mulch to hold moisture has enabled the plants to make satisfactory growth on much drier land than was originally thought possible. A regular and constant supply of moisture is essential at all times for growth of plants and fruits, but on a water-logged soil heaving occurs during the winter, roots are broken and the plants are damaged.

Varieties

Since the original breeding and selection work by Dr. F. V. Colville of the United States Department of Agriculture, assisted by Miss Elizabeth C. White of New Lisbon, New Jersey, many improved varieties have been bred in several states of the union and in Canada. The first varieties were selected from the wild and were named for the men on whose farms they were found (12). It is a matter of passing interest that the following names were derived in this way: Harding—Ralph Harding; Sam—Samuel Lemon; Adams—James Adams; Grover—Russel Grover; Rubel—Ruben Leak.

Rubel has been considered the best of these in New England and was later crossed with Grover to produce Jersey.

Of the American varieties fruiting at Kentville, the following offer promise for local conditions:

Rancocas.—Bush large and upright; leaves waxy-green; fruit large, flattened, deep blue; season late July to mid August; productive and easily rooted

Pioneer.—Bush spreading, fairly large and ornamental in appearance; leaves blue-green; fruit large, flattened, deep blue. Season follows Rancocas Productive and easily rooted.

Adams.—Bush upright; leaves dark green; fruit large, round, blue-black, having excellent flavour; yield at Kentville has been light. Ripens a week after Pioneer.

Katharine.—This variety was originally thought promising, but has been difficult to propagate and the fruit tears in picking.

In developing new varieties from seed a large proportion of worthless plants always appear and the number of useful ones is inevitably small.

Two desirable seedlings have been developed at Kentville which are worthy of trial elsewhere. These are both of unknown parentage and were grown from open-pollinated seed at the Central Experimental Farm, Ottawa.

Kengrape.—This was carried for several years under the number 15-6 and was named in January, 1941. Bush spreading vigorous; foliage large, dull green; fruit very large, blue-black oval to round, calyx prominent, produced in compact bunches as the name suggests; season mid-August; yield medium.

Kenlate.—This was on record as 15-70 until it was named in January, 1941. It is one of the latest varieties to ripen at Kentville. Bush upright, moderately strong, bark greenish-yellow; foliage deep glossy green; fruit large, oval, with heavy bloom; ripens first to mid-September; yield heavy.

A large number of new American varieties such as Burlington, Pemberton, Atlantic (4) and others, are said to have special merit. These three have not been fruited as yet at Kentville.

Preparation of Land

If a piece of new land is chosen, all the trees and bushes must be cleared off, the land ploughed and thoroughly cultivated for a year to destroy any wild

The Original Kengrape Plant. Experimental Station, Kentville, 1941.

Pioneer. Experimental Station, Kentville, 1941.

plants. Drainage, if needed, should be done at this time so that water can be maintained at about 15 inches from the surface during the growing season. Any low spots may also be filled in to avoid future wet holes.

An old piece of land requires the same attention to drainage and cultivation in order to kill weeds, rushes or grasses.

Planting

Two-year-old plants are preferable to younger ones. Early spring planting is recommended, although in British Columbia, fall planting is preferred. As little disturbance of the roots as possible should be the aim. The holes should permit an inch of the stem to be placed below ground and allow space for the roots without crowding.

The distance apart depends on the fertility of the soil and vigour of the variety. In New England the minimum distance advised is 5 feet apart in 8-foot rows, but at Kentville plants of all varieties grown have had ample room when planted 4 feet apart in 6-foot rows.

While pollination studies on blueberries have been less complete than with some other fruits, they are believed to be partially self-unfruitful. As a precaution it is desirable to have at least every fourth row a different variety. The bloom period of all varieties grown at Kentville overlaps enough to provide sufficient pollen for the purpose.

Cultivation

Clean cultivation during the first year or two after planting is usually advised and may continue as the regular practice. As the blueberry is shallow-rooted, only very shallow working is permitted near the plants. Beyond the

Rancocas (close-up of one branch). Note large fruit clusters.
Experimental Station, Kentville, 1940.

range of the branches, deeper cultivating may be done to aerate the soil and destroy weeds. Cultivation usually ends after mid-August so that growth may cease and the new twigs mature before winter.

Serious heaving during late winter and spring has occurred at Kentville, however, and after several years of clean cultivation it has been necessary to go over the plants and re-set them. To overcome this, several types of mulch have been used. A layer of 2 or 3 inches of sawdust has proved the most satisfactory. Not only have the plants remained in place but fruit yields and new growth have been much greater. Straw, hay and peat have been useful, but of less value than sawdust.

Fertilization

As the blueberry fruit is produced on the wood of the previous year, vigorous new growth is needed to maintain production. The plants respond readily to chemical fertilizer and regular, generous applications are recommended. Nitrogen gives the most conspicuous response in growth and fruitfulness but a complete fertilizer maintains a better balance of plant development. A 5-10-5 formula has given satisfactory results at Kentville. This is made up of sulphate of ammonia, superphosphate and muriate of potash. If ready mixed fertilizers are used, a 4-12-6 may be substituted.

When the plants are small the fertilizer may be spread in a circle around each one, starting with a small handful the first year and gradually increasing the amount year by year. Mature plants at Kentville receive up to 2 pounds of complete fertilizer each. The young foliage is easily injured by fertilizer and it should be applied before the buds burst or if this is not convenient, then with the greatest care to keep it away from the leaves.

Pruning

Pruning is an operation which cannot be slighted if a full crop of large fruit is to be secured. As in the low-bush type, the fruit buds for the following year are all produced on the new shoots and, to force this new growth, removal of old branches is necessary. Pruning serves a further purpose in reducing the number of fruit buds when more are present than the bush can mature.

The work is done during the dormant season. During the first two years only the weakest branches are removed as too heavy pruning retards growth. Any fruit buds or blossoms which appear in this period are also taken off so that all the plant food may be used for growth.

In later years the following procedure is advised (1):

"The pruning treatment of the different varieties varies according to the character of their growth. Those producing many shoots from the base require more thinning out of this growth than those with a few shoots. Varieties branching freely need more top-thinning than those with few branches. Varieties whose shoots have fruit buds in the terminal two-thirds or three-fourths require more cutting back than varieties whose shoots have fruit buds on the terminal one-third or fourth only.

The following outline of pruning practice is given as a general guide, not as a set of rules:—

First, remove or cut back a few of the older stems. These stems after they are 3 or 4 years old, tend to produce short weak shoots and small berries.

Second, remove all branches which are so near the ground that their fruit gets dirty.

Third, remove the shorter, weaker shoots to prevent crowding.

Fourth, cut back shoots with too many fruit buds. Usually 3 or 4 such buds on a shoot are enough because each bud produces a cluster of 8 to 12 berries. If more buds are left so many berries will develop that they will be small.

Finally cut freely to encourage new growth. If pruning the first time, seek expert advice."

SECTION II

BLUEBERRY PROPAGATION

BY

C. C. EIDT

The high-bush blueberry may be propagated from seed or cuttings.

From seed considerable variation in the resultant seedlings occurs as to size and colour of fruit and to bush type. There is, however, a general resemblance to the female parent.

Seed Propagation

Seeds of the hardier varieties, Pioneer, Katharine and Rancocas have been successfully grown. The native high-bush blueberry has also been propagated.

The method followed has been to harvest the blueberries fully ripe. The boxes of berries are stored at about 50° F. for one week. The berries are then pulped with sifted sand, using about two parts sand to one part berries.

This mass is then dried as quickly as possible. As soon as it is sufficiently dry the mass is sifted through a screen (ten mesh to the inch) and then sown. Soil is prepared as follows: two parts peat, one part good blueberry soil. The soil is placed in flats, lightly firmed and levelled. The mixture of seed and sand is rather thickly sown. This is covered with one-eighth inch of finely sifted pure peat. The flats are then thoroughly watered, using a very fine rose for this purpose. Blueberry seed should never be allowed to dry more than is necessary for planting and should be planted as soon as possible after harvested. Seed allowed to dry thoroughly may not germinate for two years.

The flats are placed out of doors in a shady location and may be covered with straw mats until germination starts, which is usually from five to six weeks. The flats are kept well watered and when cold weather arrives they are taken into the greenhouse. Very little growth occurs until early spring, when the seedlings grow quite rapidly. If a greenhouse is not available the seedling plants must be stored in a frost-proof cellar or adequately mulched out of doors, preferably in a cold frame. If left in the open the tiny plants may be destroyed by heaving.

As soon as danger of severe frost is over, the seedlings are transplanted to a nursery frame. Six inches of good soil is used in the bed, mixing one part of peat with one part of light blueberry soil. The plants are set 2 by 4 inches apart and are left until the following spring, about the first and second week in April, when they are ready to be set in permanent beds. Some protection may be given in the early stages of growth on either very cold or on very hot sunny days.

Mulching during the winter will also prevent any tendency to heave. Spruce boughs will hold a snow covering and are satisfactory.

Propagation by Cuttings

To propagate varieties true to name some method of vegetative propagation is necessary. The usual method is to use cuttings. These may be taken either as softwood (summer) cuttings or as hardwood (dormant) cuttings.

Softwood Cuttings in Propagating Frame. (Opened for photo only.)

Hardwood Cuttings in Propagating Frame. Glass removed after rooting has taken place
Propagating Frame (closed).

Softwood Cuttings.—These are taken when secondary growth starts in the summer. The blueberry starts growth early in the spring and sends out a large growth of shoots. Growth then ceases for a time. From July 1 to July 15 a secondary growth starts and at this time cuttings are taken.

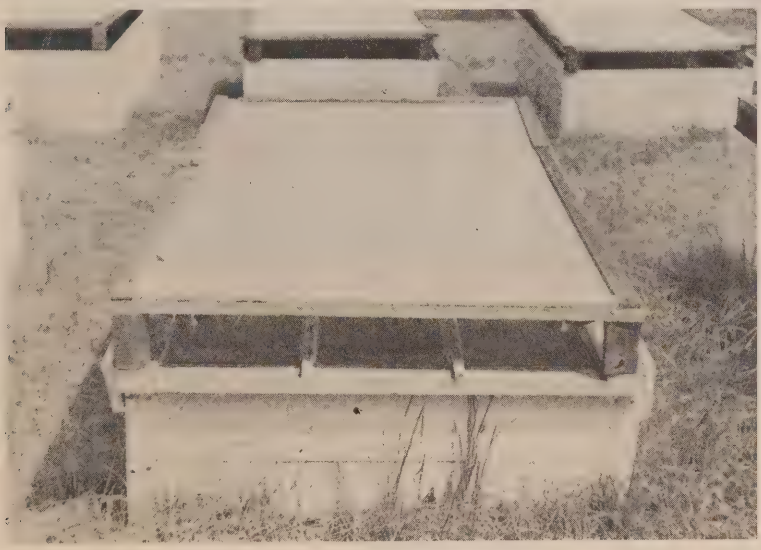
Cuttings of the current season's growth are taken usually from lateral growth rather than from long succulent growth. Each cutting is prepared by removing all the leaves except the two terminal ones with a sharp knife. The cutting is then reduced to approximately 4 inches in length, a clean transverse cut is made just below a bud and the cuttings are immediately set in peat for rooting.

Hardwood Cuttings.—Dormant cuttings may be taken any time through the winter or early in the spring before growth starts. At this Station cuttings taken in January and stored in peat have given about equal results with cuttings removed from the prunings in March.

Only one-year wood is used for these cuttings and only growths producing leaf buds are successful. The slender cuttings up to the diameter of a lead pencil are more successful than those taken from large canes thrown out the year before. In making cuttings, the large round fruit buds on the top of the shoot are removed. Below this point will be found the smaller, more pointed leaf buds. From this area the cutting is taken. A cutting 4 or 5 inches long is sufficient. At the bottom a clean cut is made just below the bud. Two cuttings can often be made from one shoot.

Cuttings are taken in January and are stored in bunches in peat. Those taken from prunings may be placed immediately in the propagation frame.

The Rooting Medium.—Most authorities recommend the use of imported peat as the rooting medium. It has been used half and half with sand in a cold frame with fairly satisfactory results or without admixture in a regular propagation frame, later described. Some attempts to use peat from local bogs have



Propagating Frame (closed).

been a failure, probably due to the fact that peats from these sources have not been sterilized and have developed a heavy growth of moulds and algae shortly after the cuttings have been set.

Batteries Nos. 1 and 2—High Bush Blueberry Propagation Project, conducted by W. T. Suckling and Miss Agnes McDonald at Lulu Island, B.C. Each battery consists of 22 frames, 3 feet wide and 8 feet long—(approximately 500 cuttings under each frame)—making a length of about 170 feet each battery. The shade covering is onion bag sacking, single thickness. Note sub-irrigation ditch, with catwalk on both sides of ditch. Black spot in centre of ditch near the far end is water table gauge. These two batteries run east and west. There are approximately 22,000 cuttings set out in these two batteries.

Courtesy, W. T. Suckling, Lulu Island, B.C.

Peat secured in 1938 from a Quebec source and packed similarly to the imported peat—that is, dried, pressed and baled—has given as satisfactory results as the imported peat. From recent tests there is every reason to believe that the American or Canadian peats, particularly those of an acid type such as is produced in Lulu Island, B.C., Port Colborne, Ont., and the Maritimes may give equal results. Lumps and clods of the material can be crushed to a workable size and roots removed by running it through a turnip pulper using shredder teeth.

Setting Cuttings.—Both hardwood and softwood cuttings are set in rows 4 inches apart and 2 inches apart in the row. The cuttings are pushed slightly slantwise into the peat until about 1 inch of the cutting, or one or two buds, remains above the peat. The cuttings are well watered and the glass sash and burlap shade are put in place.

Management.—A humid atmosphere is needed for rooting, but the number of waterings will depend to some extent on the temperature and moisture of the surrounding air. At Kentville the cuttings have usually been rooted in about 6 weeks and 3 waterings have been enough. In places where the air is drier more frequent watering may be necessary.

The chief foe of the young cutting while in the frame is the common bread mould (*Penicillium* sp.). This attacks the youngest leaves first, changing the colour from green to blue and gradually developing the typical "woolly" appearance. The leaves or buds farther down the stem may be attacked in turn. As growth of this organism occurs under conditions of excess moisture, it is important to keep the peat damp and no more. A slope of two inches toward the south prevents rain or condensed moisture gathering on the frame and dripping on the cuttings. A little ventilation is needed, usually a half-inch opening at one end, alternating the ends daily so that neither part will become too dry. In long periods of dull weather more ventilation may be necessary. If mould does occur it may be checked by drying the frame and running it in that condition for a few days.

Hardwood versus Softwood Cuttings.—Results at Kentville show that all varieties used root well as hardwood cuttings, this including Rubel, Harding, Pioneer, Katharine, Rancocas and Adams, although Katharine is more difficult than the others. Varied success has been secured with softwood cuttings of the varieties mentioned and only Rubel, Rancocas, and Adams have rooted freely. With Adams many of the softwood cuttings after rooting have produced nothing but fruit buds and have died the following year.

Management of Cuttings after Rooting.—Hardwood cuttings are rooted by the end of June. The whole tray is then removed from the propagation frame and placed in a cold frame. Some shade may be given at first. The plants are well watered until fall, then covered with two inches of sharp sand and protected for the winter with brush. Good drainage from the bed is necessary and the tray should be somewhat elevated to prevent ice forming around the plants.

Softwood cuttings are not rooted until late in the fall and require winter protection. Cuttings left out of doors in 1933-34 as above were completely destroyed by winter weather and heaving.

Cuttings removed in 1934-35 and taken into a greenhouse were successfully wintered and growth started in February. This gave them a good start for the spring and they were transplanted in early May.

The present practice is to move the entire flats to a cool cellar where severe freezing will not occur and where the temperature is fairly constant. They are taken to the nursery when danger of severe frost is over.

Both hardwood and softwood cuttings should be given one year in the nursery before they are placed in the permanent location. Nursery beds are

14. A good showing of Jersey striking—about 500 cuttings (one frame) exposed for this picture. Picture was taken three months after cuttings were set out.

Courtesy, W. T. Suckling, Lulu Island, B.C.

made with six inches of specially prepared soil, three parts good blueberry soil to one part of peat. Plants have done well set 6 by 6 inches in this soil with no winter protection.

Special Treatments with Growth Stimulants.—During the past few years special plant growth substances have been used in an attempt to stimulate the rooting of blueberries. So far, no effect has been seen from their use on hardwood cuttings at Kentville, though other growers report some success with hormone dust treatments. The materials have been decidedly beneficial to the softwood cuttings. Many varieties have been rooted as softwood cuttings which had only rooted poorly as hardwood cuttings previously.

These materials are offered by many seed and nursery supply houses under various trade names. In general, the optimum liquid treatment has been more successful with softwood cuttings than the powder form. The practice has been to place the cuttings in a glass or bowl with the bottom ends immersed to a depth of about half an inch in a dilute solution. The cuttings are trimmed, left over night in the liquid and planted the next day after about 24 hours treatment.

Results clearly demonstrate that strong solutions of hormone material produce injury to the base of the blueberry cuttings that is visible directly after treatment. The injury appears as a browning of the basal tissue. Best results have been secured where 10 parts of the pure chemical per million parts of water have been used. This is equal to one gram of pure chemical to 22 gallons of water. A marked response was secured at 5 parts per million, but at 20 parts injury was noted and above this point great harm was caused. A solution containing 10 parts per million is safe and affords a fair margin of safety above and below that concentration.

Although the optimum liquid treatment has generally given better results with cuttings of many different plants than dust treatments, the latter method is usually recommended for use by the general public. There is less danger from damage due to over treatment, and less time and labour involved in dust treatment than in the use of solutions.

Any one of the commercial preparations of hormone powder on the market may be used with safety if the manufacturer's directions are followed carefully. Just before planting, the base of a bundle of cuttings is dipped into the powder to a depth of about half an inch. The cuttings are then tapped briskly, or blown on, to remove the surplus dust before planting.

The Propagation Frame.—The blueberry may be propagated successfully in peat in a specially constructed frame. Two types of frames have been used successfully at this Station, the low and the high frame. The only difference is that the low frame is built to a height of 18 inches, the high to a height of 40 inches.

A box is constructed either 18 or 40 inches high to have an outside measurement of 3 by 6 feet. For the 40-inch height, four 10-inch boards may be used. The inside of the box should be lined with tar paper. Crosswise of the frame and 8 inches down from the top three pieces of 2 by 2 inches are set to hold the propagation tray.

A tray is made to fit snugly inside of the box on the 2 by 2 inch supports. The tray measures 5 feet 6 inches long, 2 feet 10 inches wide, outside measurement, sides 4 inches high. The bottom is covered with galvanized iron screening (four mesh to the inch) and is cross braced underneath for support.

The tray is then placed in the frame and filled level with thoroughly moistened peat. This should be left loose and not packed. An ordinary 3 by 6 foot glass sash is used to cover the frame, which leaves 4 inches head space over the peat. Above this a burlap frame is placed. This is made of 1 by 3 inch strapping covered with burlap and placed on four legs to raise the burlap 4 inches above the glass.

On the tall frame the second board from the bottom on one side should be hinged to provide underneath ventilation on warm days.

In placing the tray, any spaces between the outside of the tray and the inside of the frame should be plugged with burlap to prevent drying out from below, and the entire assembly is given a slope of 2 inches toward the south so that rain and excess moisture will not drip on the cuttings.

While these solar frames have given excellent results in Nova Scotia and in certain parts of the United States where they were first employed, their use does not appear necessary in British Columbia where ordinary cold frames, with cloth shades, are set up right in the peat bog or blueberry area at much less expense.

SECTION III

BLUEBERRY INSECTS AND THEIR CONTROL

BY

A. D. PICKETT

Blueberry Maggot

The most important insect pest of blueberries is the blueberry maggot, *Rhagoletis pomonella* (Walsh). This is recognized as identical with the apple maggot. Injury consists of the development within the berry of a small white maggot which causes premature ripening and breakdown of the fruit. It is objectionable in fresh, canned and frozen fruit and has been the cause of severe loss to many blueberry shippers.

The winter is passed in the pupal stage in the ground. The adult fly, somewhat smaller than a common house fly, emerges in July, the emergence date in any one locality varying only slightly from year to year according to weather conditions. The egg is laid beneath the skin of the fruit; a few days later the maggot hatches and remains actively feeding in the fruit for about two weeks, after which it falls to the ground, burrows in and remains for the winter. Most of the larvae emerge as flies the following year, but a fairly large number remain in the soil for two winters and a few possibly even longer.

Control.—The blueberry maggot evidently meets some measure of natural control, as it was highly prevalent in 1930 and again in 1939, with several intervening seasons of rather light infestation. Reported damage was less in 1940 than the previous year. Where forest fires in summer have burned large areas and heated the ground to an appreciable depth, maggots have been rare for many years. This, however, is highly detrimental to the blueberry plants. Ordinary spring burning removes the food supply for a season and deprives the insect of its normal place of egg laying, thus greatly reducing its numbers. The larger the area burned, the longer will it take the insects to drift in from outside. If the burning is not thorough and unburned patches are left the insects will breed rapidly in these and attack the new crop the second year after burning. Burning is an important control measure, but is not completely effective because of those insects that remain in the pupal stage in the ground for a second winter. Burning more than once every three years is not considered good cultural practice.

Coupled with rotational burning, dusting with suitable insecticides is recommended. Applications are made either by power or hand dusters on calm mornings before the dew has dried. Since the materials recommended, with the possible exception of the rotenone and derris dusts, are poisonous to humans no applications should be made later than two weeks before picking. The largest area possible should be treated since the flies move readily from place to place. It is of little value to treat a small field which is surrounded by untreated areas.

The following suggestions for the control of the blueberry maggot are based on the results of two years' investigations in Yarmouth County, N.S. Further work is necessary to definitely prove the value of these materials.

Calcium Arsenate–Hydrated Lime.—Calcium arsenate (arsenate of lime) is recommended elsewhere for the control of blueberry maggot but has caused

injury to the plants when used without safeners in Yarmouth County. When used with hydrated lime little injury developed. One pound calcium arsenate to three pounds of hydrated lime is recommended. Two applications should be made, the first when the earliest berries turn blue and the second 10 to 14 days later. Use the mixture at 20 to 24 pounds per acre per application. If the grower mixes his own dust the cost would be approximately $1.50 per acre for material for the two applications.

Lead Arsenate.—In the 1941 tests lead arsenate alone, one application at the rate of 10 pounds per acre, applied as soon as the first berries turned blue, gave promising control and caused no injury. Approximate cost per acre for materials was $1.50. This treatment has been used by a number of Yarmouth County growers for the last two years with apparent success. If further tests show this material to be efficient it will eliminate the necessity for two applications.

Cryolite (Synthetic).—Good control of maggot and no appreciable injury resulted from two applications of cryolite at the rate of 6 pounds per acre, per application. The first application should be made when the first berries turn blue and the second 10 to 14 days later. Approximate cost per acre for material for the two applications is $2.40.

Bordeaux Dust (20-40-40).—A mixture of 20 pounds dehydrated copper sulphate, 40 pounds calcium arsenate and 40 pounds hydrated lime has given satisfactory results in maggot control with no noticeable plant injury in the 1941 tests. Two applications appear to be necessary and 15 pounds per acre per application is recommended. The applications should be applied at the times indicated for cryolite. The cost of materials per acre for the two applications would be approximately $2.

On cultivated blueberries a rotenone or derris dust may be used for the control of this pest. The dust is applied 8 to 10 days after the emergence of the first flies and this is followed by one or two additional applications, as may be required, at 7- to 10-day intervals. From 15 to 20 pounds per acre of a 5 per cent rotenone dust is used for each application. This treatment is too expensive to use on blueberry barrens, but a cheaper mixture is being investigated.

The Currant Fruit Weevil

The grub of the currant fruit weevil (*Pseudanthonomus validus* Dietz.), a small snout beetle, develops in the fruit of the blueberry and sometimes exceeds the blueberry maggot in numbers. The female beetle deposits her eggs in the calyx lobes of the berries while they are small and green. The tiny grub which emerges from the egg in late June or early July is white in colour with a light brownish head, and feeds on the pulp of the berry for approximately a month until mature. The mature grub changes to a pure white pupa inside the berry and remains in this stage for about 9 or 10 days. Usually, when the first berries are ripe both the grubs and the pupae may be found, but within a week or 10 days practically all the grubs will have turned to pupae, and a week or so later most of the infested berries will have disappeared.

In early August the weevils begin to appear. These are very small reddish-brown beetles, somewhat less than one-eighth of an inch long, and having the characteristic long snout of the weevil. The beetles feed on the berries but unless very numerous the damage done in this way is negligible.

Control.—No work has been done on the control of this insect on the blueberry but observations made over a two-year period suggest that the insect is of no importance on newly burned areas except when this operation has not been well done. For export shipments or for processing, the berries should be

examined in the same way as for the blueberry maggot and if weevils are found in appreciable numbers picking should be deferred until the test indicates that the pest has left the fruit.

Chain-spotted Geometer

The chain-spotted geometer (*Cingilia catenaria* Drury), is a periodical pest of blueberries in various parts of Eastern Canada where it may completely destroy the foliage and fruit under outbreak conditions. In addition to blueberry, it attacks many other plants commonly found growing on blueberry lands. Sweet fern appears to be its preferred food plant, but rhodora, huckleberry, cranberry, wild spiraea and many others may be attacked. Under severe outbreak conditions it may defoliate many species of decidious trees and conifers after the foliage of the low-growing plants is destroyed.

The caterpillars are yellowish in colour with prominent black spots along the sides and when fully grown reach a length of one and one-half to nearly two inches. Like all geometers or measuring worms, they move with a typical looping motion. The caterpillar stage occurs from early June until late in August. The moths, which are day fliers, may be found during September and October. They lay their eggs mostly on the leaves of sweet fern and other plants. These later drop so that the eggs winter over in the dead leaves on the ground. The moths may be distinguished by their smoky white, almost transparent wings, the outer edges of which are marked by faint black lines and several distinct black spots.

Control.—Few experiments on control have been carried out but preliminary tests indicate that applications of arsenicals or cryolite either in the spray or dust form will give control if properly applied. A single test with a pyrethrum dust indicated that this material may be used with considerable success. When the caterpillars are migrating in large numbers from one location to another, as they frequently do in severe outbreaks, an area a few yards wide in front of them may be treated. Treatments when the caterpillars are small will usually be more effective than when they near maturity.

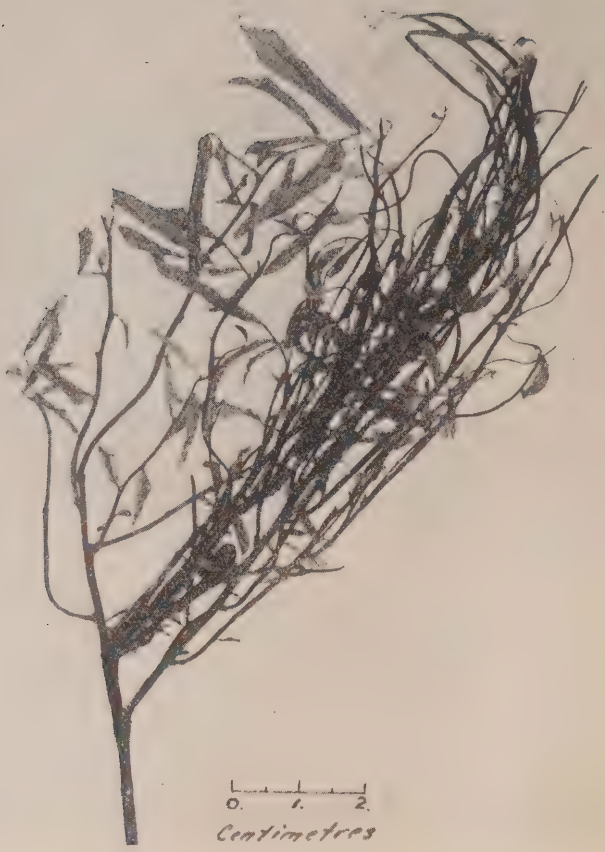
Other Blueberry Insects

Many other native insects feed occasionally on the foliage of the blueberry but few cause serious injury where regular burning of the barrens is practised.

The blueberry leaf beetle, *Galerucella vaccinii* Fall., has sometimes caused damage in New England. The adult overwinters among the debris near the stems, feeding in the spring on the expanding buds. Egg-laying begins about the time the pollen is shed and may continue for nearly two months. The larvae feed on the under surface of the leaves, usually one larva to a leaf, and leave only a network of small veins. Tested on 83 species of plants both larvae and adults fed freely on all high and low-bush blueberries but rejected other food. Under natural conditions this insect is said to feed only on the low-bush type. The recommended control consists of periodic burning and arsenical sprays or dusts.

The blueberry flea beetle, *Altica torquata* Lec., is also a common insect and yields to the same treatment. It has not been reported as a serious pest in Canada.

In the few high-bush plantations in the Maritimes, no insects of great importance have made their appearance. The fall webworm, *Hyphantria cunea* Drury, when prevalent, may attack the blueberry. The unsightly webs can be checked as soon as they appear by a rotenone dust applied with a hand duster or they may be removed by cutting out the infested part and burning or crushing the caterpillars.



12. Witches' broom on wild blueberry. Caused by fungus *Calytospora goeppertiana*.

SECTION IV

DISEASES OF THE BLUEBERRY

BY

J. F. HOCKEY

Blueberry plants are subject to parasitic diseases much the same as many agricultural crops. Some diseases attack the foliage causing leaf spots, or mildew; others attack the fruit causing it to shrivel or rot, and another attacks the stems causing a witches' broom development of the affected part. Any of these diseases may affect the crop but under Maritime conditions there has seldom been a serious outbreak of disease on blueberries. The following brief notes may help in the identification and control of those found in the wild or cultivated plants.

Red Leaf Spot

Occasional plants may be found with brilliant red leaves during June or July. The leaves produce a white mass of mould-like growth on the lower surface before gradually drying up and falling in mid-summer. This conspicuous disease is caused by a fungus, *Exobasidium vaccinii* Wor. It is readily distinguished from the reddening of foliage caused by mildew or drought. Periodical burning has given satisfactory control of this disease in other districts.

Mildew

Blueberries are quite susceptible to mildew caused by the fungus *Microsphaera alni*, var. *vaccinii* (S.) Sal. which in favourable seasons of moist weather may cause a partial defoliation early in the season. There is no conspicuous leaf spot associated with mildew but frequently the leaves turn reddish prior to falling. Affected leaves are quite susceptible to dust injury.

Witches' Broom

The presence of balsam fir in the vicinity of blueberry plants has a decided influence on the prevalence of the stem rust fungus, *Calyptospora Goeppertiana* Kühn. on blueberries. When this fungus attacks the blueberry plant, it causes a characteristic swelling of the stems and profuse development of shoots which result in the production of a "witches' broom". The witches' broom is fairly conspicuous on account of its upright, compressed appearance. Affected plants seldom produce more than two-thirds of a crop. Burning has no effect on the control of the rust but the elimination of balsam fir from the barrens and borders of barrens will reduce the disease.

Fruit Rot

In moist seasons twig blights and fruit rots may occur on blueberries due to the activity of a Sclerotinia or a Botrytis fungus. Either of these fungi will cause a fruit rot and both are favoured by similar weather conditions. A greyish mould develops on affected fruit which gradually shrivels as the season advances.

Other occasional fungus fruit rots may be found but they are seldom of any appreciable importance.

General

Blueberry plants are quite susceptible to dry soil conditions and react by the foliage reddening as in the autumn. Berries are usually smaller under these conditions and early defoliation of the plants follows. Plants suffering from drought are susceptible to dust injury, particularly from arsenicals. Where heavy coatings of arsenical dust have been made on plants, injuries may appear in the form of spots with or without concentric rings, or as marginal burning. Such plants defoliate soon after the injury is apparent.

Fungicide Dusts

Little experimental work has been done with fungicides on blueberries in Nova Scotia. In the state of Maine it has been found that dusting at blossom fall and again 10 to 14 days later has protected the foliage from disease and increased the yield of blueberries, particularly the year after burning. The dusts were applied at rates to give 10 to 13 pounds of monohydrated copper sulphate per acre. These rates were obtained by using approximately 35 pounds per acre of a 38 per cent copper lime dust or 50 pounds per acre of a 20 per cent copper lime dust. Arsenicals for insect control may be added to such dust mixtures in the proportions necessary to give the desired application rate per acre.

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